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Angles (1) and (2) being equal:

$$\frac{35x^2}{x(x^2+17^2.18^2)}=\frac{9}{x}, \text{ or } 26x^2=3^2.17^2.18^2;\ x^2=\frac{3^2.17^2.18^2}{26}.$$

$$x=\pm\frac{3.17.18}{\sqrt{26}}=\pm3.17.9\sqrt{\tfrac{2}{13}}=\pm180.0346.$$

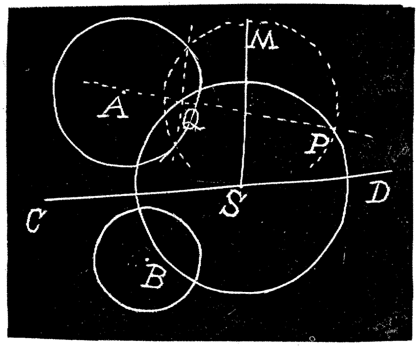
SANDERS AND KRAMER.

Also solved by V. M. Spunar and J, Scheffer.

373. Proposed by S. LEFSEHETZ, East Pittsburg, Pa.

Draw a circle passing through a given point and orthogonal to two given circles.

Solution by A. R. MAXSON, Columbia University, New York City.



Let P be the given point, and A and B the centers of the given circles. Draw CD, the radical axis of circles A and B. The required circle must have its center in CD. Again, remembering that the common chord of circle A and a circle described on AP as diameter cuts AP in a point Q, inverse of P with respect to circle A, construct Q and draw MS, the perpendicular bisector of QP cutting CD in S. S is the center of a circle of radius SP that passes through P and is orthogonal to circles A and B. We know that any circle through two points inverse with respect to a given circle is orthogonal to that circle. MS is, in our case, the locus of centers of circles through the inverse points P and Q. In particular, then, the circle of center S, S being in CD, must satisfy all the conditions of the problem.

Also solved by J. Scheffer, V. M. Spunar, S. G. Barton, C. N. Schmall, and the Proposer.

CALCULUS.

296. Proposed by C. N. SCHMALL, New York City.

Two currents C_1 and C_2 produce deflections ϕ_1, ϕ_2, respectively, in a tangent galvanometer. When is $(\phi_1-\phi_2)$ a maximum?

I. Solution by the late G. B. M. ZERR, Ph. D.

Let $G=2\pi n/r$=principal constant of the galvanometer. H=earth's horizontal magnetic force. $H/G=1/C$. Then $\tan\phi_1=CC_1$, $\tan\phi_2=CC_2$.

$\therefore u=\phi_1-\phi_2=\tan^{-1}(CC_1)-\tan^{-1}(CC_2)$.

$$\frac{du}{dC_1}=\frac{C}{1+C^2C_1^2},\quad \frac{du}{dC_2}=-\frac{C}{1+C^2C_2^2},$$

$$\frac{d^2u}{dC_1^2}=-\frac{2C^3C_1}{(1+C^2C_1^2)^2},\quad \frac{d^2u}{dC_2^2}=\frac{2C^3C_2}{(1+C^2C_2^2)^2},\quad \frac{d^2u}{dC_1dC_2}=0.$$

Now $\dfrac{d^2u}{dC_1^2}\,\dfrac{d^2u}{dC_2^2}<\dfrac{d^2u}{dC_1dC_2}$.

Hence there is no maximum unless $C_1=\infty$, $C_2=-\infty$.

II. Solution by V. M. SPUNAR, Chicago, Ill., and the PROPOSER.

By the principle of the instrument, we have

$$\frac{\tan\phi_1}{\tan\phi_2}=\frac{c_1}{c_2}.\quad \therefore \frac{\tan\phi_1-\tan\phi_2}{\tan\phi_1+\tan\phi_2}=\frac{c_1-c_2}{c_1+c_2}\ldots(1).$$

But by trigonometry,

$$\tan\phi_1-\tan\phi_2=\frac{\sin(\phi_1-\phi_2)}{\cos\phi_1\cos\phi_2},\quad \tan\phi_1+\tan\phi_2=\frac{\sin(\phi_1+\phi_2)}{\cos\phi_1\cos\phi_2}.$$

Hence (1) becomes

$$\frac{\sin(\phi_1-\phi_2)}{\sin(\phi_1+\phi_2)}=\frac{c_1-c_2}{c_1+c_2},\text{ or }\sin(\phi_1-\phi_2)=\left(\frac{c_1-c_2}{c_1+c_2}\right)\sin(\phi_1+\phi_2).$$

Hence, $(\phi_1-\phi_2)$ is a maximum when $\sin(\phi_1+\phi_2)$ is maximum; that is, when $\sin(\phi_1+\phi_2)=1$; that is, $\phi_1+\phi_2=\frac{1}{2}\pi$.

297. Proposed by PROF. L. C. WALKER, Socorro, New Mexico.

A square hole $2s$ on a side is cut through an ellipsoid, axes $2a$, $2b$, $2c$, the axis of the hole coinciding with the axis $2c$ of the ellipsoid. Find (1) the volume, and (2) the surface removed.

Solution by J. SCHEFFER, A. M., Hagerstown, Md.

The volume $V=8c\int_0^s dx\int_0^s dy\sqrt{1-\left(\frac{x}{a}\right)^2-\left(\frac{y}{b}\right)^2}$